REVIEWS

The Population Bomb. By Paul R. Ehrlich. xiv + 223 pp., Ballantine Books, New York. 1968. $.95.

An argument of extreme importance for biologists and the future of mankind is raging within the rapidly-growing profession of futurology. One pole is represented by Kahn and Wiener, who argue in *The Year 2000: A Framework for Speculation on the Next Thirty-Three Years* that despite great increases in the world population, a trouble-free world is the most likely prospect for the next few decades. The opposite pole is represented by the book under review. A very large number of experts is lined up on both sides, and it is important to understand why reasonably well-informed people can have such remarkably different points of view. We will consider the basic issues in Ehrlich's book and explain why his critics err when they take issue with him.

1. The most basic contention Ehrlich makes is that there will be large-scale starvation in the world in about a decade, involving considerably more than the present 3½ million deaths per annum from this cause. Related to this point, he contends that family planning has been a failure, the impressive new strains of the cereal grains may lead to a variety of serious problems resulting in lower production than expected, and the maximum amount of animal protein we can get from the world's oceans is only about double the present annual catch. The optimists point out, on the other hand, that world rice production rose 12% in 1967, the take from the oceans increased sharply in Japan and Norway last year, and family planning can work, because the birth rate per capita is dropping sharply in the U. S. and elsewhere. In this bewildering barrage of facts, claims, and counterclaims, who is right? In general, there are three explanations for the discrepancies: successes tend to be well publicized, whereas typically only the real experts know about failures or omens of doom; there is a widespread tendency to underestimate the complexity of many problems, so that important factors are ignored in making predictions; and finally, many of the "experts" in this whole complex of problems are in fact only experts on one aspect. Physicists may not realize how little they know about epidemiology, and agronomists may overestimate their grasp of the current situation in fisheries, for example. In the case of the cereal grains, while the success with new strains is well known, the international crisis developing because of pesticide resistance in cotton pests is not. In general, few people grasp the basic ecological facts about pesticides: they generally produce a less serious long-term effect on the populations of pests than on the populations of parasites and predators that would normally control the pests, because of higher initial pest densities; as spray calendars draw on a greater variety of chemicals, cross-resistance to a wide variety of chemicals develops in the pests, so that there is rapid selection for pests that can withstand anything that can be used against them; and no matter what the details are of a control program, the long-term consequences of pest buildup are likely to be worse where the largest possible acreage is planted to the same species and variety. One of the best-informed books available on the future for cereal grains is Paddock and Paddock's *Famine 1975!,* for which the title gives the plot.

Two lines of argument support Ehrlich's contention that oceanic production cannot be enormously increased: a theoretical argument and one based on the history of exploited marine resources. The former is that much of the world's oceans are aquatic deserts because of inadequate upwelling of minerals, and further, since we typically harvest predators, there is great thermodynamic conversion inefficiency in harvesting food pyramids several steps removed from incident solar energy. Also, it would take too many calories per calorie obtained to make seiving plankton out of sea water a profitable activity in most parts of the oceans. The historical argument is that given the current economic demand for animal protein and the long experience exploiting most major oceanic stocks, how is it that many of these have shown an actual decline in yield over the last several decades if we have only begun to tap the resource?

The magnitude of the impending population-unplanned family catastrophe can best be grasped by studying a typical village in an underdeveloped country in detail, as in Gilbert Etienne's *Studies in Indian Agriculture*. To a considerable extent it has been possible to prevent massive catastrophe up to the present by increasing the proportion of all available land under cultivation. However, just about all land that could possibly be cultivated is now under cultivation, yet the population keeps increasing. Thus, mass famine can only be averted by increasing yield per acre, but thermodynamic realities impose an upper asymptote on this figure.

2. Ehrlich notes that pandemics may be a great problem in the near future, a point not made by many experts. The fact is that plague, for example, could break out on a fearful scale in India. Precisely those conditions that allowed a resurgence of plague in India in the 1940's are found there again: large numbers of rats per person moving freely through warehouses full of American grain shipments, with inadequate efforts being made to kill the rats or board up holes. Plague can explode with such speed that it could overwhelm public health organizations.

3. Ehrlich notes that we are seriously polluting the planet. The magnitude of this problem is not well known. Smog from Los Angeles is having a serious effect on plants far to the east of the surrounding mountains, and some authorities state that it is now causing enormous losses in agricultural productivity. Emphysema death rates are among the most rapidly rising variables on earth.

In general, it appears that more familiarity with existing data would show that it is Ehrlich's critics who err, not Ehrlich.—KENNETH E. F. WATT, Department of Zoology, University of California, Davis.

Rocky Mountain Flora. By WILLIAM A. WEBER. vii + 437 pp., 346 fig. University of Colorado Press, Boulder. 1967. $9.40.

"This book, a revision of the *Handbook of Plants of the Colorado Front Range,* culminates twenty years of intensive field and laboratory studies of the Rocky Mountain flora." It is a field guide to the "Ferns, conifers, and flowering plants of the Southern Rocky Mountains from Pikes Peak to Rocky Mountain National Park and from the plains to the Continental Divide. . . . Over 1,500 kinds of plants [1,400 species, cf. p. 2] are keyed and classified. The book is small enough to be carried in a rucksack [but not a pocket], and only a hand magnifier is needed to make the necessary examinations."

The introductory pages include a tantalizing review of why the vegetation of the Front Range is more than a "green blur." Weber points out that the flora of the Southern Rockies includes some taxa that are circumpolar; reoccur in the mountains of Central Asia; or are Tertiary relicts. The paragraphs on "Plant Geography" lead one to expect an important digest, but instead one is abandoned with a parsimonious list of examples on p. 6 and a reference to an earlier paper (Weber, W. A. 1965. Plant geography in the southern Rocky Mountains. *In* H. E. Wright, Jr., and D. F. Frey (editors). The Quaternary of the United States. Princeton Univ. Press, New Jersey.) which will not be available to many for whom this book is intended. This list, which could have kindled a lot of interest, is disappointing inasmuch as extraterritorial occurrences in the text frequently are neglected. None of the three endemics mentioned on p. 6 is clearly indicated in the text as not occurring elsewhere; one of these, *Aletes acaulis,* also occurs in New Mexico and Texas and must have been a mistake for *A. anisatus*. The selection of *Aralia racemosa* as an example of an "Eastern Woodland-prairie" cognate ought to have been explained as this species is not otherwise included in this book.

The remainder of the book is organized like its predecessor, as a continuous series of keys without the interjection of descriptions and the frills of endless measurements and literature citations. The first key leads to helpful categories such as Parasites (here including saprophytes), Aquatics, Vines, Monocots, Woody Dicots, and